



[4910-13-P]

**DEPARTMENT OF TRANSPORTATION**

**Federal Aviation Administration**

**14 CFR Part 39**

**[Docket No. FAA-2012-0060; Directorate Identifier 2012-NE-02-AD; Amendment 39-17123; AD 2012-14-09]**

**RIN 2120-AA64**

**Airworthiness Directives; Pratt & Whitney (P&W) Division Turbofan Engines**

**AGENCY:** Federal Aviation Administration (FAA), DOT.

**ACTION:** Final rule.

**SUMMARY:** We are adopting a new airworthiness directive (AD) for certain P&W PW4000 series turbofan engines. This AD was prompted by reports of 3<sup>rd</sup> and 4<sup>th</sup> stage vane fractures in the low-pressure turbine (LPT) of certain PW4000-94" and PW4000-100" turbofan engines. This AD requires dimensional inspections of LPT 3<sup>rd</sup> stage vanes and the rear turbine case, inspection of LPT 4<sup>th</sup> stage vanes at the next LPT overhaul and removal of vanes with non-conforming airfoil fillet radii and vanes with more than one strip and recoat repair. This AD also requires disassembly and reassembly of the 2<sup>nd</sup> stage high-pressure turbine (HPT) rotor and 3<sup>rd</sup> stage LPT rotor at the next HPT and LPT overhauls. We are issuing this AD to prevent 3<sup>rd</sup> and 4<sup>th</sup> stage vane fractures in the LPT, damage to the LPT rotor, uncontained engine failure, and damage to the airplane.

**DATES:** This AD is effective [INSERT DATE 35 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER].

**ADDRESSES:** For more information about this AD, contact James Gray, Aerospace Engineer, Engine Certification Office, FAA, Engine & Propeller Directorate, 12 New England Executive Park, Burlington, MA; phone: 781-238-7742; fax: 781-238-7199; e-mail: [james.e.gray@faa.gov](mailto:james.e.gray@faa.gov).

## **Examining the AD Docket**

You may examine the AD docket on the Internet at <http://www.regulations.gov>; or in person at the Docket Management Facility between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays. The AD docket contains this AD, the regulatory evaluation, any comments received, and other information. The address for the Docket Office (phone: 800-647-5527) is Document Management Facility, U.S. Department of Transportation, Docket Operations, M-30, West Building Ground Floor, Room W12-140, 1200 New Jersey Avenue SE., Washington, DC 20590.

**FOR FURTHER INFORMATION CONTACT:** James Gray, Aerospace Engineer, Engine Certification Office, FAA, Engine & Propeller Directorate, 12 New England Executive Park, Burlington, MA; phone: 781-238-7742; fax: 781-238-7199; e-mail: [james.e.gray@faa.gov](mailto:james.e.gray@faa.gov).

## **SUPPLEMENTARY INFORMATION:**

### **Discussion**

We issued a notice of proposed rulemaking (NPRM) to amend 14 CFR part 39 to include an AD that would apply to the specified products. That NPRM published in the Federal Register on March 2, 2012 (77 FR 12755). That NPRM proposed to require dimensional inspections of 3<sup>rd</sup> stage vanes and the rear turbine case. That NPRM also proposed to require inspection of 4<sup>th</sup> stage vanes at the next LPT overhaul and removal of vanes with non-conforming airfoil fillet radii and vanes with more than one strip and recoat repair. That NPRM also proposed to require disassembly and reassembly of the 2<sup>nd</sup> stage HPT rotor and 3rd stage LPT rotor at the next HPT and LPT overhauls.

### **Comments**

We gave the public the opportunity to participate in developing this AD. The following presents the comments received on the proposal and the FAA's response to each comment.

### **Agreement With the Proposed AD**

Two commenters, Boeing and FedEx, agreed with the intent of the proposed AD.

### **Request to Change Compliance Time for the 4<sup>th</sup> Stage Vanes**

One commenter, China Cargo Airlines, requested that we change the inspection compliance time for the LPT 4<sup>th</sup> stage vanes from “next LPT overhaul” to “next engine overhaul.” The commenter stated that LPT overhauls are typically performed every other shop visit, which could be in six-to-eight years. The commenter thought that the risk of having a 4<sup>th</sup> stage vane failure during that time was too high.

We do not agree. We determined that performing the inspections at the next LPT overhaul after the effective date of the AD provides an acceptable level of safety, and that we do not need to reduce the interval. We did not change the AD.

### **Request for Credit for Prior Compliance**

FedEx requested that a statement be included authorizing credit for prior compliance as they have already been performing the requirements of the proposed AD.

We do not agree. Paragraph (e) of the proposed AD already allows credit for prior compliance. That paragraph states to comply with the AD within the compliance times specified, unless already done. We did not change the AD.

### **Request to Reference Pratt & Whitney Special Instruction No. 17F-09**

One commenter, Martinair Holland, requested that we add a reference to Pratt & Whitney Special Instruction No. 17F-09 as an alternate method of compliance (AMOC) for paragraph (e)(1)(iii). The commenter stated that they have been checking the 3<sup>rd</sup> stage vanes for adequate engagement using that Special Instruction.

We do not agree. The AD requires dimensional inspections that are not included in Special Instruction No. 17F-09. Also, we do not include AMOCs in the requirements of an AD. You may, however, seek an AMOC using the procedures specified in the AD. We did not add that Special Instruction reference to the AD.

### **Request to Add Service Bulletins as Alternate Methods of Compliance**

Martinair Holland, United Airlines, and Onur Air, requested that we add references to Pratt & Whitney Service Bulletins (SBs) PW4ENG 72-798, PW4ENG 72-804, and PW4G-100-72-221, as alternate methods of compliance to paragraph (e)(1)(v). The commenters stated that they have been inspecting the LPT 4<sup>th</sup> stage vanes using these SBs.

We do not agree. Paragraph (e) of the proposed AD states to comply with the AD within the compliance times specified, unless already done. If you have already done the proposed actions, then no further action is required to comply with paragraph (e)(1)(v). Also, as noted above, we do not include AMOCs in the requirements of an AD. We did not change the AD.

### **Request to Include the Part Numbers (P/Ns) of the LPT 4th Stage Vanes**

Pratt & Whitney requested that we include the P/Ns of the LPT 4<sup>th</sup> stage vanes that are subject to the one-time strip and recoat requirement. The commenter stated that it is possible that future designs of LPT 4<sup>th</sup> stage vanes would not be restricted to a single strip and recoat requirement.

We agree. We listed the P/Ns of the affected LPT 4<sup>th</sup> stage vanes in the AD.

### **Request to Define the Word “Guidance”**

United Airlines requested that we define the word “guidance” which we used in paragraph (g) of the proposed AD, or, that we revise the wording to specifically detail the inspection/build procedure to be used. The commenter states that using the term “guidance” does not denote a specific requirement and only suggests a general direction to be followed.

We agree. Use of the word “guidance” in this AD may have caused confusion. We deleted the “guidance” paragraphs listed under Related Information from the AD.

### **Request to Update Guidance Service Information**

Pratt & Whitney and United Parcel Service Co. (UPS) requested that we add the words “or later” after the service information date references in paragraph (g) of the proposed AD. They also requested that we clarify that the referenced service information could be updated, and compliance to that updated service information would be acceptable. One of the commenters was concerned that service information listed as guidance would be controlled in the same way as service information that is incorporated by reference in the AD.

We do not agree. We do not know how documents will be revised in the future. This AD, however, was revised to remove references to related service information, and therefore the comment no longer applies. We did not change the AD.

### **Request to Remove the Term “Overhaul”**

United Airlines and UPS requested that we remove the term “overhaul,” such as “LPT overhaul” and “HPT overhaul” from the proposed AD compliance, as the term “overhaul” is not industry standard and therefore subjective. The commenters suggested a few alternatives to use instead of the term “overhaul.”

We partially agree. We do not agree that the term “overhaul” should be removed, but we do agree that it should be defined. We added a definition paragraph which states that, for the purpose of this AD, an overhaul is when all disks in the rotor are removed from the engine and the blades are removed.

### **Request to Clarify Approved Methods of Compliance**

UPS requested that we clarify that the service information listed under Related Information are approved methods of compliance to the proposed AD. They further stated that, as-written, it is not clear that they are approved methods of compliance.

We agree that the AD should be clarified. We revised the AD by removing references to related service information.

### **Request to Duplicate the Strip and Recoat Requirements**

United Airlines requested that we duplicate the strip and recoat requirements and make them part of Inspection/Check-01 or Inspection/Check-03 of the PW4000 Engine Cleaning Inspection and Repair (CIR) Manual. The commenter stated that the strip and recoat limits are currently located in repair-14 of the PW4000 CIR Manual, but repair-14 is not always required to return a vane cluster to service. The commenter stated that the strip and recoat requirements need to be part of the normal inspection process.

We do not agree. The AD mandates that the inspection be performed once, at the next LPT overhaul. That inspection will purge the fleet of LPT 4<sup>th</sup> stage vanes that have had more than one strip and recoat repair. After that inspection, LPT 4<sup>th</sup> stage vanes are not allowed to have more than one strip and recoat repair, as specified in the installation prohibition paragraph (f). Revising the engine manuals to relocate the inspection requirements is unnecessary. We did not change the AD.

### **Request to Remove Reference to 4<sup>th</sup> Stage Vanes with an Unknown Number of Strip and Recoat Repairs**

United Airlines stated that there is no way to identify vanes with an unknown number of strip and recoat repairs. The commenter stated that if there were no markings on the vane, it would indicate that no strip and recoat repairs were performed. This could lead to scrapping vanes that could otherwise be repaired and returned to service.

We agree. We changed the AD to eliminate the reference to LPT 4<sup>th</sup> stage vanes with an unknown number of strip and recoat repairs.

### **Request to Make the CIR Inspections More Specific**

United Airlines requested that in proposed AD paragraph (e)(1)(iv) we make the CIR inspections more specific for the LPT case dimensions. The commenter stated that there are different ways to perform the measurements and it is not clear whether the dimension to measure is based on an average or an individual diametric dimension.

We do not agree. A specific measurement technique is not defined because multiple measurement techniques exist that are acceptable. The only diametric dimensional inspection required by the AD is index 24, which would be acceptable to measure based on an average dimension. We did not change the AD.

#### **Request to Change “Ensure Adequate Engagement”**

United Airlines requested that in proposed AD paragraphs (e)(1)(iii) and (e)(1)(iv), we change “ensure adequate engagement” to “dimensionally inspect the applicable LPT case slot serviceable dimensions and 3<sup>rd</sup> stage vane serviceable dimensions per the appropriate CIR.” The commenter also requested that we list the specific dimensions to inspect by index number. The commenter stated that no mechanic can deduce what an adequate engagement is because it is not specific enough.

We agree. We changed paragraph (e)(1)(iii) to “dimensionally examine index 13 through index 34 of the LPT 3<sup>rd</sup> stage vane cluster assembly.” We also changed paragraph (e)(1)(iv) to “dimensionally examine index 23 and index 24 of the vane engagement slots on the rear turbine case, where the 3<sup>rd</sup> stage vane is installed.” We also listed the specific dimensions to inspect by index number, and included the supporting figures in this AD.

#### **Request to Eliminate Paragraphs**

United Airlines requested that we eliminate paragraphs (e)(1)(ii) through (e)(1)(iv) and (e)(2). The commenter stated that these paragraphs are related to procedures that are in the engine manual that operators are already performing. If they are left in the AD, they will add a significant burden in the amount of time and paperwork required to manage and verify compliance to the AD.

We do not agree. The actions in the paragraphs the commenter wants eliminated from the AD represent changes to the manuals that were specifically incorporated to address 3<sup>rd</sup> and 4<sup>th</sup> stage vane failures. Although air carriers operating under 14 Code of

Federal Regulations (CFR) Part 121 are likely using the most current versions of the engine manuals, not all operators, for example, part 91 operators, may be required to incorporate the latest versions of the engine manuals. Therefore, we must maintain these requirements in the AD to ensure that all operators comply to resolve the unsafe condition. We did not change the AD.

### **Revision to Cost of Compliance**

In reviewing the cost of compliance estimate made in the NPRM (77 FR 12755, March 2, 2012), we determined that we were unable to substantiate our prorated cost estimate for limiting the number of strip and recoat repairs since we do not know how many vanes are operating with more than one strip and recoat repair. We, therefore, removed the estimate of the useful part life expectancy and only included the replacement parts cost. The total cost estimate changed from \$32,147,170 to \$9,214,170.

### **Conclusion**

We reviewed the relevant data, considered the comments received, and determined that air safety and the public interest require adopting the AD with the changes described previously. We have determined that these changes:

- Are consistent with the intent that was proposed in the NPRM (77 FR 12755, March 2, 2012) for correcting the unsafe condition; and
- Do not add any additional burden upon the public than was already proposed in the NPRM (77 FR 12755, March 2, 2012).

We also determined that these changes will not increase the economic burden on any operator or increase the scope of the AD.

### **Costs of Compliance**

We estimate that this AD affects 807 engines installed on airplanes of U.S. registry. We estimate that it will take 2 work-hours per engine to perform the LPT 3<sup>rd</sup> stage vane cluster assembly and rear turbine case inspections. The average labor rate is



\$85 per work-hour. We expect that about 1,870 LPT 4<sup>th</sup> stage vane cluster assemblies will be found with the non-conforming casting identification. Replacement parts cost about \$4,854. Based on these figures, we estimate the cost of the AD on U.S. operators to be \$9,214,170.

### **Authority for this Rulemaking**

Title 49 of the United States Code specifies the FAA's authority to issue rules on aviation safety. Subtitle I, section 106, describes the authority of the FAA Administrator. Subtitle VII: Aviation Programs, describes in more detail the scope of the Agency's authority.

We are issuing this rulemaking under the authority described in Subtitle VII, Part A, Subpart III, Section 44701: "General requirements." Under that section, Congress charges the FAA with promoting safe flight of civil aircraft in air commerce by prescribing regulations for practices, methods, and procedures the Administrator finds necessary for safety in air commerce. This regulation is within the scope of that authority because it addresses an unsafe condition that is likely to exist or develop on products identified in this rulemaking action.

### **Regulatory Findings**

This AD will not have federalism implications under Executive Order 13132. This AD will not have a substantial direct effect on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government.

For the reasons discussed above, I certify that this AD:

- (1) Is not a "significant regulatory action" under Executive Order 12866,
- (2) Is not a "significant rule" under DOT Regulatory Policies and Procedures (44 FR 11034, February 26, 1979),
- (3) Will not affect intrastate aviation in Alaska, and

(4) Will not have a significant economic impact, positive or negative, on a substantial number of small entities under the criteria of the Regulatory Flexibility Act.

**List of Subjects in 14 CFR Part 39**

Air transportation, Aircraft, Aviation safety, Incorporation by reference, Safety.

**Adoption of the Amendment**

Accordingly, under the authority delegated to me by the Administrator, the FAA amends 14 CFR part 39 as follows:

**PART 39 - AIRWORTHINESS DIRECTIVES**

1. The authority citation for part 39 continues to read as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701.

**§ 39.13 [Amended]**

2. The FAA amends § 39.13 by adding the following new airworthiness directive (AD):

2012-14-09 **Pratt & Whitney Division**: Amendment 39-17123; Docket No.

FAA-2012-0060; Directorate Identifier 2012-NE-02-AD.

**(a) Effective Date**

This AD is effective [INSERT DATE 35 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER].

**(b) Affected ADs**

None.

**(c) Applicability**

This AD applies to the following Pratt & Whitney Division turbofan engines:

(1) PW4000-94" engine models PW4050, PW4052, PW4056, PW4152, PW4156, PW4650, PW4060, PW4060A, PW4060C, PW4062, PW4062A, PW4156A, PW4158, PW4160, PW4460, and PW4462 including models with any dash number suffix.

(2) PW4000-100" engine models PW4164, PW4164C, PW4164C/B, PW4168, PW4168A, PW4164-1D, PW4164C-1D, PW4164C/B-1D, PW4168-1D, PW4168A-1D, and PW4170.

**(d) Unsafe Condition**

This AD was prompted by reports of 3<sup>rd</sup> and 4<sup>th</sup> stage vane fractures in the low-pressure turbine (LPT) of certain PW4000-94" and PW4000-100" turbofan engines. These fractures caused an uncontained engine failure and an LPT case puncture, and resulted in multiple in flight shutdowns. We are issuing this AD to prevent 3<sup>rd</sup> and 4<sup>th</sup> stage vane fractures in the LPT, damage to the LPT rotor, uncontained engine failure, and damage to the airplane.

**(e) Compliance**

Comply with this AD within the compliance times specified, unless already done.

(1) At the next LPT overhaul, do the following:

(i) Remove LPT 4<sup>th</sup> stage vanes that have a P/N listed in Table 1 to paragraph (e) of this AD from service if more than one strip and recoat repair has been performed.

**Table 1 to Paragraph (e) – Affected LPT 4<sup>th</sup> Stage Vane P/Ns**

50N174	50N674-01	51N174-001	51N374-001	52N574-01
50N474-01	50N774-01	51N174-002	51N674-01	52N674-01
50N474-001	50N774-001	51N174-003	52N274-01	51N774-01
50N574-01	51N174-01	51N374-01	52N474-01	52N774-01

(ii) Re-assemble the 3<sup>rd</sup> stage LPT rotor blades by alternating heavy blades next to light blades and balancing blades of similar weights 180 degrees across the rotor.

(iii) Dimensionally examine index 13 through index 34 of the LPT 3<sup>rd</sup> stage vane cluster assembly. Use Table 2 to paragraph (e) of this AD and Figure 1, Figure 2, and

Figure 3 to paragraph (e) of this AD to determine whether the vane is eligible for installation.

**Table 2 to Paragraph (e) – Determination of Vane Eligibility**

<b>Inspect:</b>	<b>Eligible for Installation Limits:</b>
13	1.820 – 1.830 inches (46.23 – 46.48 mm)
14	1.920 – 1.930 inches (48.77 – 49.02 mm)
15	3.200 inches (81.280 mm) Basic
16	0.900 inch (22.860 mm) Basic
17	0.365 inch (9.271 mm) Basic
18	0.350 inch (8.890 mm) Basic
19	0.160 inch (4.064 mm) Basic
20	0.772 inch (19.609 mm) Basic
21	72° Basic
22	22.382 inch (568.503 mm) Radius – Origin on Plane S Basic
23	21.052 inch (534.721 mm) Radius – Origin on Plane S, concentric with Index 8 Basic
24	Angle from Plane S to Plane SL 3° 4' 37" Basic
25	Angle from Plane S to Plane SM 6° 9' 14" Basic
26	90° Basic for typical airfoil section
27	
Distance from rear foot outer diameter surface to airfoil section along Planes S, SL, and SM.	
For Section B-B:	5.241 inches (133.121 mm)
For Section E-E:	3.181 inches (80.797 mm)
For Section J-J:	1.935 inches (49.149 mm)
28	
Airfoil chord at Section J-J (1.935 inches	1.346 inches (34.188 mm) minimum

(49.149 mm) from rear foot outer diameter surface at Planes S, SL, and SM)	
At Section E-E (3.181 inches (80.797 mm) from rear foot outer diameter surface at Planes S, SL, and SM)	1.314 inches (33.376 mm) minimum
At Section B-B (5.241 inches (133.121 mm) from rear foot outer diameter surface at Planes S, SL, and SM)	1.188 inches (30.175 mm) minimum
<hr/>	
29	
Airfoil thickness at Section J-J (1.935 inches (49.149 mm) from rear foot outer diameter surface at Planes S, SL, and SM)	0.239 inch (6.071 mm) minimum
At Section E-E (3.181 inches (80.797 mm) from rear foot outer diameter surface at Planes S, SL, and SM)	0.183 inch (4.648 mm) minimum
At Section B-B (5.241 inches (133.121 mm) from rear foot outer diameter surface at Planes S, SL, and SM)	0.139 inch (3.531 mm) minimum
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30	0.062 inch (1.575 mm)
Distance to trailing edge measurement	
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31	0.030 inch (0.762 mm) minimum
Airfoil trailing edge thickness	
<hr/>	
32	0.315 – 0.324 inch (8.001 – 8.230 mm)
Dimension	diameter
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33	6.785 – 6.795 inches (172.34 – 172.59 mm)
Dimension	
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34	0.692 – 0.714 inch (17.58 – 18.14 mm)
Dimension	
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**Figure 1 to Paragraph (e) - Determination of Vane Eligibility**

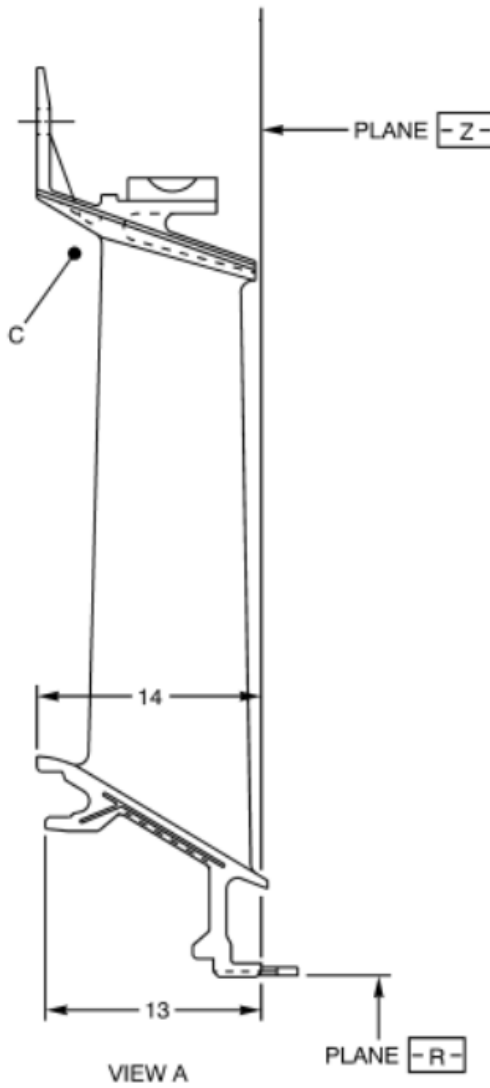
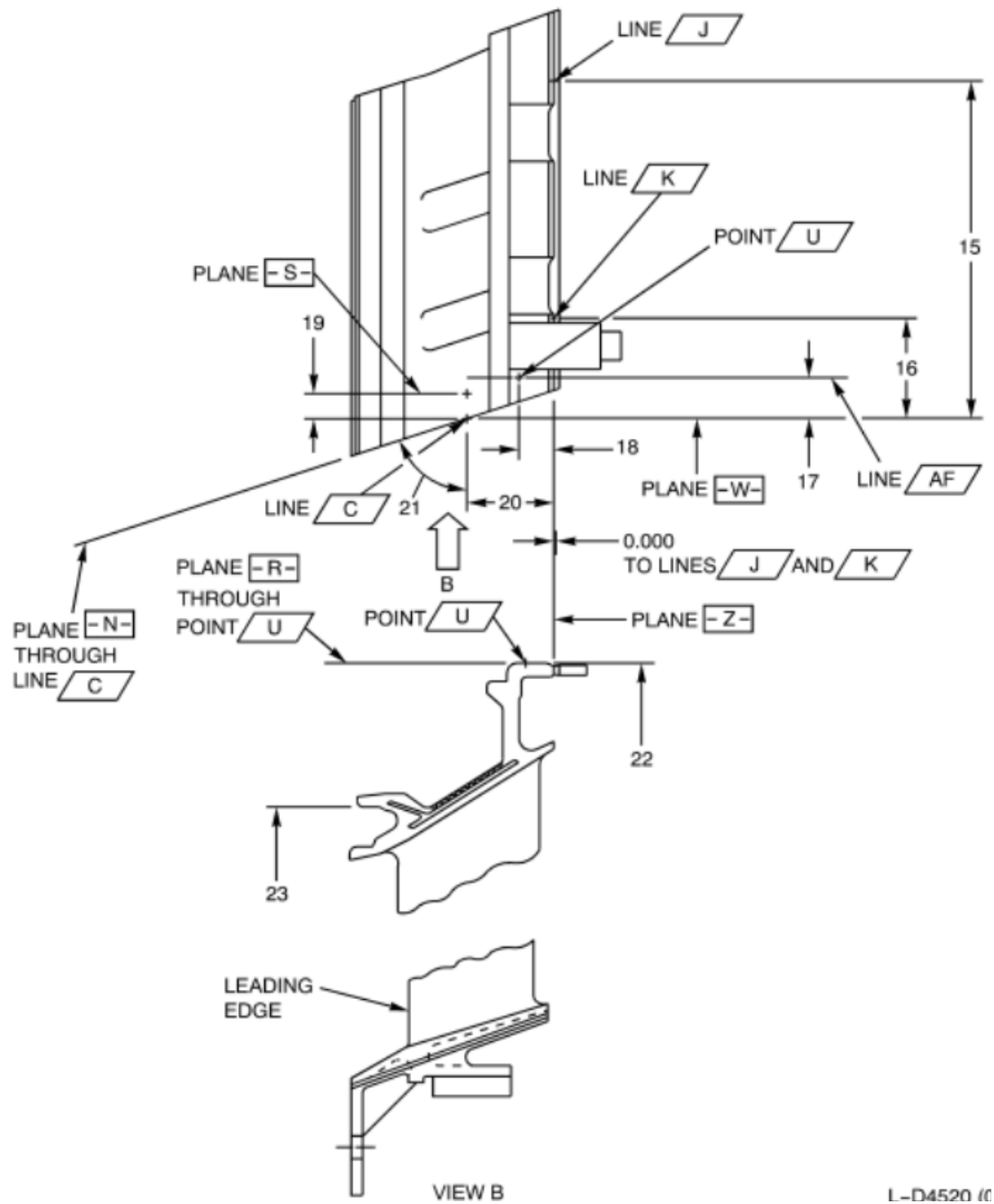
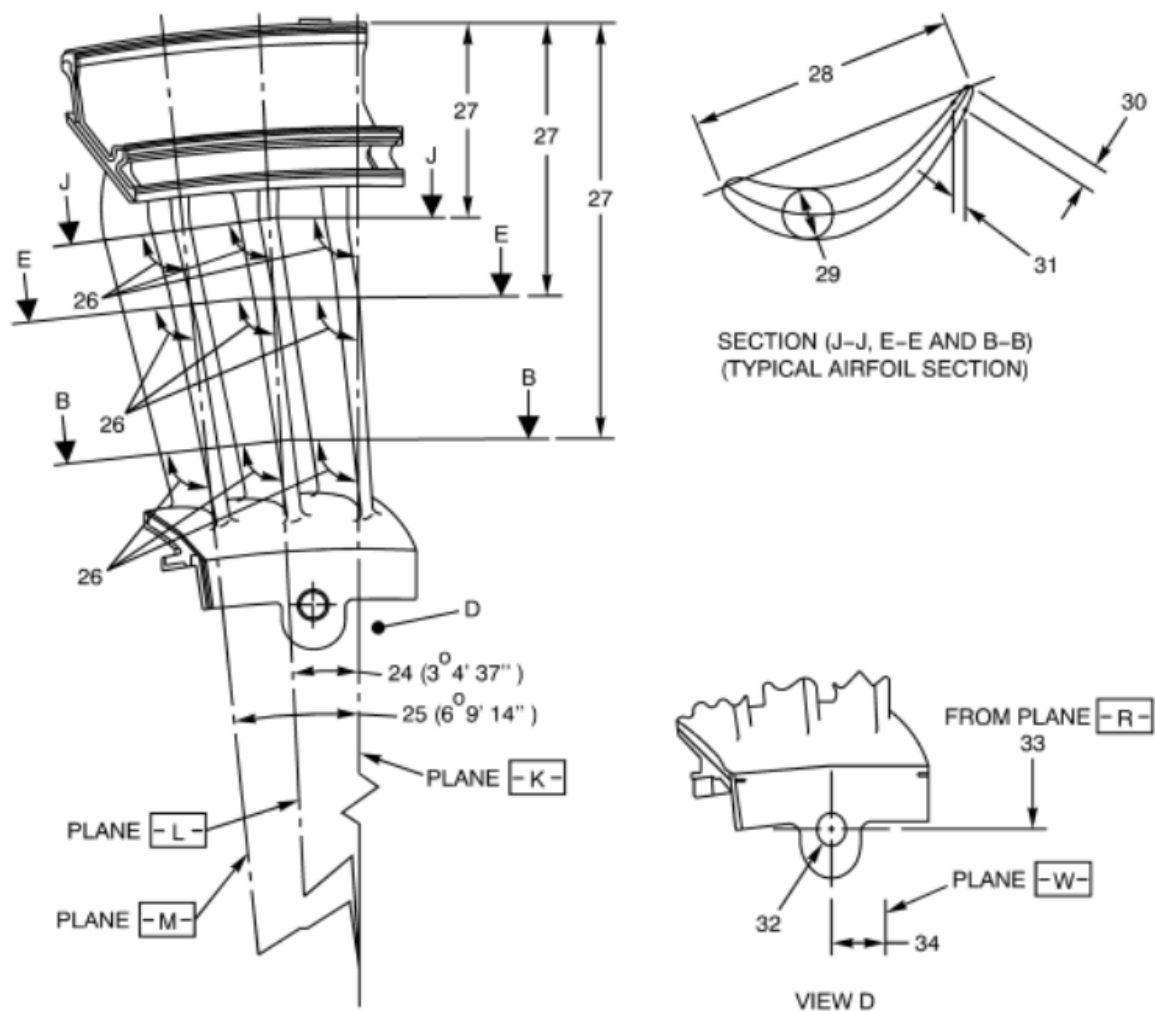


Figure 2 to Paragraph (e) - Determination of Vane Eligibility



L-D4520 (C)

**Figure 3 to Paragraph (e) - Determination of Vane Eligibility**



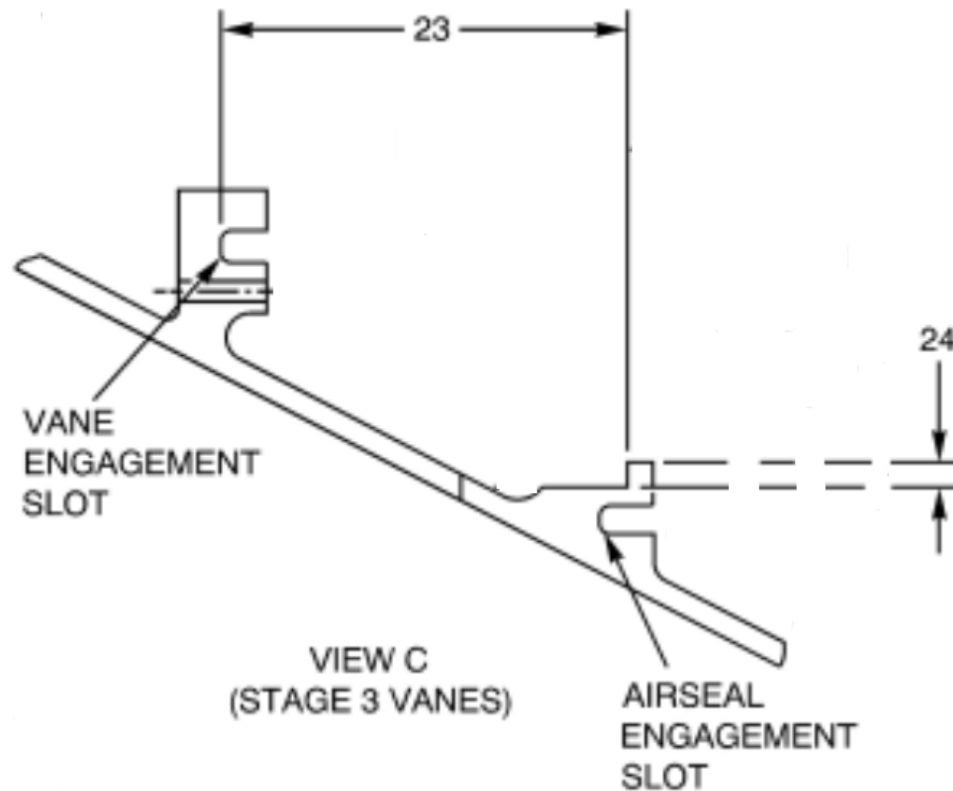
(iv) Dimensionally examine index 23 and index 24 of the vane engagement slots on the rear turbine case, where the 3<sup>rd</sup> stage vane is installed. Use Table 3 to paragraph (e) of this AD and Figure 4 to paragraph (e) of this AD to determine whether the case is eligible for installation.

**Table 3 to Paragraph (e) - Determination of Case Eligibility**

Inspect:	Eligible for Installation Limits
23	1.875 inch (47.625 mm) minimum
24	0.097 inch (2.464 mm) minimum



**Figure 4 to Paragraph (e) - Determination of Case Eligibility**



(v) Inspect the 44 LPT 4<sup>th</sup> stage vane cluster assemblies P/N 52N774-01 for casting identification “51N554AT 1447 2S1C1” and P/N 52N674-01 for casting identification “51N454AT 655 2S1C1.” Remove the vane cluster assembly from service if either of these casting identifications is found.

(2) At the next high-pressure turbine (HPT) overhaul, re-assemble the 2<sup>nd</sup> stage HPT rotor blades by alternating heavy blades next to light blades and balancing blades of similar weights 180 degrees across the rotor.

**(f) Installation Prohibition**

After the effective date of this AD, do not install or reinstall into any engine any LPT 4<sup>th</sup> stage vanes with a P/N listed in Table 1 to paragraph (e) of this AD that are at piece-part exposure and have had more than one strip and recoat repair.

**(g) Definitions**

(1) For the purpose of this AD, an HPT or LPT overhaul occurs when all disks in the rotor are removed from the engine and the blades are removed.

(2) For the purpose of this AD, piece-part exposure means that the part is removed from the engine and completely disassembled.

**(h) Alternative Methods of Compliance (AMOCs)**

The Manager, Engine Certification Office, FAA, may approve AMOCs for this AD. Use the procedures found in 14 CFR 39.19 to make your request.

**(i) Related Information**

For more information about this AD, contact James Gray, Aerospace Engineer, Engine Certification Office, FAA, Engine & Propeller Directorate, 12 New England Executive Park, Burlington, MA; phone: 781-238-7742; fax: 781-238-7199; e-mail: james.e.gray@faa.gov.

**(j) Material Incorporated by Reference**

None.

Issued in Burlington, Massachusetts, on September 20, 2012.

Diane M. Cook,  
Acting Manager, Engine & Propeller Directorate,  
Aircraft Certification Service.

[FR Doc. 2012-23791 Filed 10/02/2012 at 8:45 am; Publication Date: 10/03/2012]